ENGINEERING COMMUNICATORS: AGENDA SETTING IMPACTS ON PERCEPTIONS OF COMMUNICATION FOR ENGINEERING STUDENTS

By

Lindsey Heaney

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APPROVED:

Karen Taylor, Committee Chair
Richard Hum, Committee Member
Erin Trochim, Committee Member
Peter DeCaro, Chair
Department of Communication and Journalism

Abstract

What is effective communication? Within the job industry, communication is a sought after and valued skill when it comes to hiring employees. The engineering field is no different with communication skills being an important component of the discipline through project management and working with others from a variety of backgrounds. However, there is a gap between what the engineering profession is expecting and what is being produced from college institute engineering programs regarding communication skills. To better understand this phenomenon, message constructs regarding communication in course materials and perceptions from engineering students were examined through anonymous surveys and curriculum analysis. Through the lens of agenda-setting theory, clear themes between course materials and the surveys center around emphasis on the end result and the use of god-terms when referring to communication. Furthermore, communication by example with faculty and staff play a key role in the way students perceive and understand communication's role within the profession.

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Introduction

Most students pursue a college education to help them prepare for their desired careers and to help prepare themselves for the workforce. Colleges are tasked with educating, training, and informing students of the essential knowledge and skills needed to succeed in their specialty or field of interest. Therefore, how are colleges preparing students to meet modern communication demands within the engineering field?

Industry Calls for Communication

Employers rank communication skills as most important, according to Archer and Davison (2008) within the International Employer Barometer (IEB) survey. The survey asked large to small scale companies what skills they considered most important when hiring graduates. Overall, the survey shows that employers rank communication skills as most important when hiring. Showing consistent demand over time with little variation across decades or industries, the National Association of Colleges and Employers (2018) explains that their Job Outlook Survey 2019 asked 172 employers what skills and qualities they look for in graduates. The survey found written communication skills to be most valued. The findings in support of communication skills in the workplace continues with Hansen and Hansen (2010) examining multiple studies that identified employable skills. Their summary of these studies describes communication skills as the most mentioned by employers as a skill needed. Furthermore, Winsor, Curtis, and Stephens (1997) surveyed 1,000 managers regarding their hiring practices, job performance, important courses for management, and management profiles. Their survey data showed that communication skills were ranked highest in several aspects of employment, such as skills for successful job performance and most important when hiring college graduates.

Being able to effectively speak, listen, and write are important to employers. When looking for new hires, employers focus on skills centered around communication, relationship building, work ethic, and problem solving (Johnson, 2006). Furthermore, communication skills are in the top rankings for most important college courses for entry-level management. The skills that were ranked highest to lowest in importance included communication, interpersonal communication, management, and public speaking.

From Industry Need to the Curriculum

Industry has made it clear that communication skills are important for effectively obtaining employment and advancing careers. However, even though the industry has pointed out these needed skills, college graduates are not quite meeting the call. According to Bauer-Wolf (2018), The National Association of Colleges and Employers reported in their 2018 Job Outlook Survey that 201 employers were asked to rate various skills based on the level of quality they experience with college graduates. The findings concluded that employers found college graduates to only be 41.6 percent proficient in oral and written communication skills.

Likewise, a study by Hart Research Associates for the Association of American Colleges and Universities (2018) asked 500 hiring managers and 501 business executives through an online survey to measure the value of a college education as well as what is most important for college students to learn. They found that hiring managers and business executives did indeed find value in college education and that both written and oral communication were among the most important skills needed. However, these skills that hiring managers and business executives found to be important are also skills that they believe college graduates are lacking. The study results show that both hiring managers and business executives find communication to be most

important, but only 40 percent of business executives and 47 percent of hiring managers said college graduates were prepared in this area.

Not only is communication shown to be lacking among graduates, it also appears to be a complex topic. A study conducted by Griffin, Cangelosi, and Hargis (2014), surveyed 244 undergraduate students and asked them to rank five characteristics (strong work ethic, integrity, communication skills, dependability, and dedication) that they perceive to be least important to most important for employers. The students ranked communication skills as the third most important to employers, but their opinions of the importance of communication skills varied. The participants gave a variety of rankings when asked to rank the importance of communication from one (most important) to five (least important). This shows that even though communication was deemed the third most important to the students, there was a level of complexity regarding its importance. With research showing a lack of communication skills in college graduates and college graduates showing mixed beliefs regarding its importance, this presents a potential gap between higher education and industry needs.

Background

Role of Communication in Engineering

Group work and interpersonal skills. Professional engineers that are in the workforce have shown that communication, both written and verbal, take up the majority of their time (Baren, 1993; Dunn-Rankin et al., 1998; Piirto, 2000). More specifically, the engineering field is known for teamwork and working with others through various projects (Anderson et al., 2010; Rompelman, 2000; Vest, Long, & Anderson, 1996). In fact, engineers are often asked to work with others outside of their profession through collaborative projects, such as with planners, construction managers, lawyers, environmental specialists, and more (Chan & Fishbein, 2009;

Farr & Brazil, 2009; Hening & Koonce, 2015). Lingard and Barkataki (2011) explain that engineering is a collaborative field with many projects being accomplished over a long period of time as a team. Not to mention that the ABET criteria for accredited engineering programs emphasizes the need for group skills to be taught to engineering graduates. Therefore, college engineering programs often give exercises or semester long projects that force students to practice these skills, particularly interpersonal communication. Interpersonal communication is defined quantitatively and qualitatively. Adler and Proctor II (2007) describe interpersonal communication quantitatively as a dyadic form of interaction between two people. They state the qualitative form of interpersonal communication as when people treat the other uniquely and it is the quality rather than quantity that matters.

Lingard and Barkataki (2011) argue that these communication skills are not being taught correctly in the classroom and have not developed the proper assessment of such skills. They explain that engineering students are tasked with creating formal presentations and report writing within a short deadline (i.e. within the semester or quarter term). This can cause students to focus more on the actual product rather than the collaborative process to create it. In fact, Lingard and Barkataki (2011) continue to explain that students are often evaluated on their group work skills based on the end product as opposed to their interactions with others in the group over a long period of time.

The Engineering Industry

Employers within the engineering industry complain that engineering graduates still lack the communication as well as teamwork skills within the field (Felder, 2012). Donnell et al. (2011) describe a survey conducted by The American Society of Mechanical Engineers that asked mechanical engineering department heads and engineering industry representatives if they

thought engineering graduates were proficient in communication skills. Of the 68 department heads surveyed, 52 percent thought they were proficient. However, of the 1,000 engineering professionals and managers, only 9 percent thought they were proficient. This suggests a knowledge gap within the higher education engineering curriculum and the professional engineering field.

Much of the responsibility lies within academia to sufficiently train and prepare graduates for the communication demands of the workforce. In fact, a study by Aller (2001) found that engineering companies expected their new hires to have strong communication skills. However, they did not provide them with post-hire communication training nor communication related professional development opportunities. This would insinuate that new engineering hires would gain most of their formal communication training through their college programs.

Engineering Students: The Engineering Identity

Analytical and Quantitative

A study conducted by Lumsdaine and Lumsdaine (1995) looked at the thinking preferences of engineering students at the University of Toledo. They found that the majority of engineering students were analytical and quantitative thinkers. They claim that the students are being "cloned" into analytical thinkers similar to their teachers and that the engineering program was avoiding the teamwork and interpersonal training that is desperately needed within the engineering industry.

Structure and Rules

In support of this previous study's findings, a study by Ford (2006) examined a college engineering course and asked the students about their perceptions regarding writing and speaking. The results suggest that engineering students needed structure and set rules to follow

when conducting writing and speech preparations. When given templates or instructions, engineering students saw those as formulas rather than starting points. In fact, Ford (2006) describes engineering students as having a "rule-following" nature, which could influence the way communication is observed, understood, and practiced.

Deductive

Dannels (2002) examined communication within the engineering discipline based on lectures and courses given to students. The study found that incorporating communication was met with more complexity than simply helping with public speaking delivery, such as eye contact and avoiding verbal or vocallic fillers. Engineering faculty and students used speaking at a more in-depth level, mainly through translation. The study explains that engineering students were told that sticking with evidence, using visuals, and presenting their information in a deductive way established them as a professional engineer. This suggests that oral communication within an analytical framework shapes the engineering identity.

Attempts to Shift the Curriculum

Creative Problem Solving

Even though Lumsdaine and Lumsdaine (1995) identified engineering students as analytical thinkers, they also identified a brief shift in thinking when the program introduced a new creative problem-solving course. They concluded that incorporating creative problem solving within the curriculum created a shift from analytical thinking to more innovative or imaginative thinking. In fact, they suggest that in order to meet the industry need for better communicators and collaborators, faculty need to incorporate more creative problem solving in their courses to spark a more interpersonal way of thinking. This can also be seen with more recent attempts.

Communication and Ethics

According to Felder (2012), there is an emerging paradigm within the engineering field that shifts from a focus on science and mathematics to more integration of communication and ethics. Therefore, courses within engineering programs are introducing communication skills at some level.

ABET Engineering Criteria

We can see communication being included at a broader level as well. Engineering students follow an accreditation program within their institute. The Accreditation Board for Engineering and Technology sets the standard for accredited engineering programs. According to the ABET website, they are a "non-profit, non-governmental agency that accredits programs in applied natural science, computing, engineering, and engineering technology". As of 2019, the criteria set by ABET that programs must meet for accreditation includes *Criterion 3. Student Outcomes* and *Criterion 5. Curriculum*. Such outcomes are skills, behaviors, or knowledge that students are expected to obtain upon graduation. These particular criteria include communication expectations by stating:

> 3. an ability to communicate effectively with a range of audiences;
>
> 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

The Knowledge Gap

In order to address the knowledge gap regarding group skills for engineering students entering into the workforce, Kisselburgh, Berkelaar, and Buzzanell (2009) call for STEM and

communication researchers to address messaging at an institutional level that may be creating this gap:

> STEM and communication researchers as well as STEM practitioners should examine the ambient and indirect messages and strategic absences provided by educational institutions preparing future engineers, scientists, and technologists— the direct and discrete messages evidenced in textbooks, curriculum, teacher language choices, and marketing through organizational documents and Web sites. (2009, p. 390)

Agenda-Setting Theory at the Institutional Level

By examining the messages that students are given regarding communication in the classroom setting, one must consider the agenda being set at the institutional level. McCombs and Shaw's (1972) agenda-setting theory is well known for identifying and measuring impacts of news coverage on the public's perceptions regarding the importance of certain issues (McCombs, 2018). This original theoretical framework has focused on the mass media at a national level and its influence on the public. However, the theory has since expanded outside of this framework. For instance, even with the media covering different aspects of a given topic, salience or the perceived importance of a certain aspect can influence the public agenda on the topic. McCombs and Shaw (1993) explain that the media can influence not only what we think about, but also how we think about it. Through the concept of marketplace of ideas, agenda-setting theory has not only been used at a social or public level, but also at an individual level (McCombs & Shaw, 1993). Carroll and McCombs (2003) offer a better understanding through mass media impacts on the reputation of corporations. They found that news regarding businesses contribute to the attitudes that the public has toward individual firms.

Additionally, agenda-setting theory revolves around the idea that the level of importance or salience moves from one specific agenda to another agenda (Carroll & McCombs, 2003). With this basic understanding, the agenda-setting theory has been used to examine various campaigns. This study aims to apply agenda-setting by looking at the influence of the institutional agenda and its effects on student perception of communication applications and skills within their area of study. Even though agenda-setting has been used at the macro level, agenda-setting can have impacts at an individual level (Shehata & Strömbäck, 2013). Furthermore, it's argued that agenda-setting occurs within the information processing of the individual (Bulkow, Urban, & Schweiger, 2012). Information within an academic setting often boils down to the faculty and student interaction. Ford and Riley (2003) explain that engineering faculty must include communication guidance in the classroom in order for students to view communication as an important component within the engineering field as part of the internal processing of the individual. Therefore, this study aims to examine possible knowledge gaps within communication skills. Such gaps are examined through the discourse at the institutional level by further examining the influence of the institutional agenda on individual students.

Discourse Analysis

Discourse plays a critical and influential role within the realm of agenda setting. Students are exposed to continuous discourse throughout their years in school. From day one, students are given their course syllabus that outlines expectations and objectives. Through the academic year, students are exposed to a structure of knowledge and practice through lectures, readings, assignments, and more. Within this structure, Tracy and Robles (2013) describes institutional interaction as having "turn-taking systems that are a hybrid between the two extremes of locally managed and preallocated. In business meetings, for instance, there is often an agenda that order

topics of talk and the person who is the meeting chair gets to decide when to close down one topic and start the next topic". In particular, college classroom settings can be a complex environment with instructors preparing students for the workforce while in an academic system, which can cause contradictions between the professional workforce and school.

Engineering Discourse

A study conducted by Dannels (2003) examined select engineering courses at a university that taught presentation skills. The researchers interviewed faculty that taught these courses. The study found that within the classroom, there were contradictions between workplace and school systems involving audience, identity, and structure. Students were often challenged with needing to speak at a technical level for their fellow classmates and instructor while at the same time were expected to present in simple terms for non-technical audiences. Furthermore, students were faced with having to take on two identities: professional engineer and student. According to Kisselburgh, Berkelaar, and Buzzanell (2009), the present-day framing in the STEM field still focuses on technical or scientific discourse that were emphasized in the past, but "innovation, knowledge, connectivity, and global perspectives are the new discourse of this century".

Methods

Research Question 1: Are engineering students at UAF being given resources on communication based skills within their area of study? If so, what are the message constructs?

Research Question 2: If engineering students at UAF are being given resources, what are their perceptions of communication based on these resources?

Data Collection

Curriculum analysis. To address research question number one, a curriculum analysis was conducted within the University of Alaska Fairbanks' (UAF) College of

Engineering and Mines. A snowball sampling was utilized (Coleman, 1958; Goodman, 1961; Heckathorn, 2011) by asking department chairs and staff within the college to provide the names of any faculty that emphasize communication in their courses. Those faculty members that were recommended were emailed and asked to provide the researcher with any materials that address communication topics (science communication, presentation techniques, etc.) or any communication related task (presentations, projects, etc.) that students would receive while taking their course(s). Materials were provided for five courses that consist of petroleum engineering, engineering science and management, and electrical engineering. Materials that were provided by faculty that addressed communication skills, group communication skills, or oral presentation skills were examined. These materials received by the researcher include syllabi, rubrics, lecture material, and a textbook.

Survey. To address research question number two, an anonymous online survey was made available to university engineering and science undergraduate students. Any university undergraduate student 18 years or older with a declared major in the College of Engineering and Mines could participate. The survey link and study announcement was sent through various channels at the university through fliers, department listservs, student chapters and clubs, the university internal newsletter, and by contacting individual departments as well as faculty to share with their students.

Survey questions. The survey asked three demographic based questions regarding the participant's status with the university and area of study. The participants were then asked a series of multiple choice and open-ended questions. The questions asked participants to disclose what resources related to communication they have been provided from their classes, their perception of communication based on those resources, and their overall

understanding of communication. The survey question number seven includes areas documented within the engineering field that require communication skills (Darling & Dannels, 2003; Sageev & Romanowski, 2001; Turiman et al., 2012; Wolfe, 2009).

Q1	What is your current class standing?
Q2	Please indicate your declared major at UAF.
Q3	How many UAF classes related to your major have you completed as of now?
Q4	What resources have you been given that relate to the topic of communication within your major? Check all that apply. a. Course materials b. Lectures c. Class discussion d. Homework assignments e. Projects f. Other - fill in the blank g. None
Q5	Based on the resources you selected (if any), what is your perception of communication?
Q6	What does communication mean to you?
Q7	Where do you believe communication is important within your major or area of study? Check all that apply. h. Teamwork i. Management j. Technical writing k. Data visualization l. Public speaking m. Interpersonal skills n. Training o. Other - fill in the blank p. None
Q8	Please give an example where better communication would have been helpful within your major or area of study.
Q9	Anything else that you would like to add?

Table 1. Questions sent out to students through an anonymous online survey.

Qualitative Analysis

The survey responses and materials were recorded and analyzed using grounded coding (Owen, 1984). Thematic patterns were identified within the responses and material constructs through keywords and similar concepts, which created distinct codes (Mayring, 2004; Labuschagne, 2003). Common codes were used when possible to categorize similar patterns observed between the materials and the survey responses.

Results

Originally, the survey and request for course materials were sent out to the College of Engineering and Mines and the College of Natural Science and Mathematics to examine data within STEM. However, course material from five geoscience courses were provided with only one geoscience survey participant. No biology course material were provided, but eight biology survey responses were collected. Due to the mismatch of data for the science disciplines from lack of faculty and student involvement, this data was not included in the analysis since the study focuses on the agenda-setting materials within a specific area of study and the communication perceptions of students within that area of study. The researcher did receive course materials for five engineering courses and received data from 27 surveys from engineering students. Therefore, the engineering discipline was examined.

Course Material Themes

Course materials were provided from the course instructors for five engineering courses that ranged from 100-600 level. Class materials from both undergraduate and graduate courses were included since instructors allow select undergraduates into graduate level courses and some courses are cross-listed. Materials related to communication were examined that

specifically address communication, such as body language, communication skills, public communication, and oral presentation skills. In addition, any rubrics or guidelines related to communication were examined, such as oral presentations or rubrics regarding group communication for teamwork.

Structure. The concept of communication is structured. In fact, the Shannon-Weaver sender-receiver model is referenced. A textbook provided to engineering students provides a chapter on communication that emphasizes the Shannon-Weaver model concept. The Shannon-Weaver model diagrams are shown of the sender, channel, receiver, encoding, decoding, and noise. Furthermore, an engineering textbook breaks down communication by using a formula to determine the probability that a communication interaction will be successful by offering the following example: P(success)=0.8^3=0.512. The formula assumes three probabilities within communication to occur: 1) the sender sends the correct message; 2) the channel of communication works correctly; 3) the receiver interprets the message correctly. Each of these three probabilities are given a value of 0.8. The structure component of communication focuses on the details, such as font size within email or presentation slides. In fact, the visual aid component during oral presentations is emphasized with guidance related to content amount, font, background, and images or graphs, for instance.

Professional standard. The materials provided center communication within the professional setting. Communication is related to scenarios or situations within the field. For instance, students are given lecture material based on how to negotiate during projects, conducting emails or phone messages with clients, and what forms of communication are appropriate based on the project. Students are often given mock professional scenarios to consider and complete tasks accordingly. The lecture materials regarding the professional

materials center around the client. Students are provided lecture material that address how to interact with others in what is considered to be professional within the engineering profession through email and in-person meetings.

Teamwork focused. Many of the materials and class curriculum focus on teamwork, particularly group-based projects. Students are often asked to work with their peers on a group project or task. Students are expected to work together and practice group communication skills. Their ability to work well with others is included as part of their overall grade, which is either determined through the group project quality and/or having groups give feedback on their fellow group members' teamwork skills.

God-terms. When explaining communication in course materials, the words *effective*, *effectively*, and *ineffective* were used when describing the act of communication. Examples of this include "Rules for effective meetings", "Effective team depends on..." and "Skills ineffective. Makes little or no effort to improve". Some materials listed the ABET criteria by stating "an ability to communicate effectively with a range of audiences." However, there is no indication of defining or explaining further what *effective* means. In this context, these overarching terms seem to hold the ultimate value when describing communication, which could be considered a god-term coined by Kenneth Burke. These terms give motivation and are used to shape action and are regarded as setting the standard as the ultimate (Burke, 1969). However, Burke does describe a possible negative of god-terms as the possibility of being overused, which causes them to be used universally instead of used to fit the specific given context in which they are intended to be used.

Survey Themes

The anonymous survey collected 27 submitted responses. Demographics collected from the survey participants show majority held a senior class standing and majority were students in the mechanical or petroleum engineering programs. The multiple-choice questions revealed that projects, discussions, and materials are the top resources given related to communication and teamwork, management, and interpersonal skills are the top areas where communication is perceived as important.

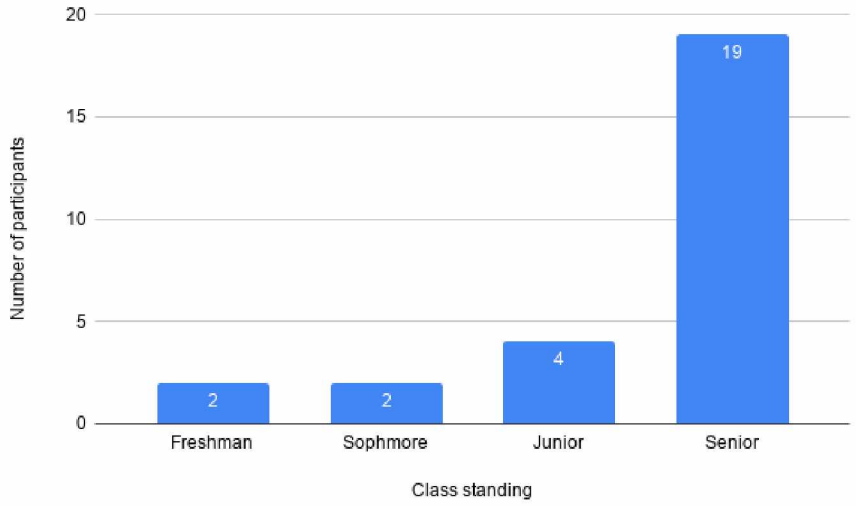

Figure 1. Demographic results for question one of the anonymous survey that asks participants to disclose their class standing.

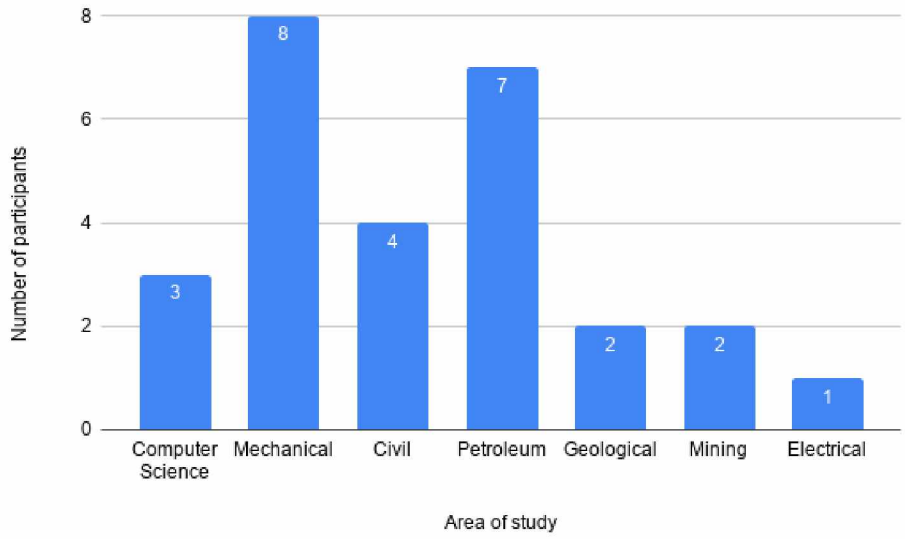

Figure 2. Demographic results for question two of the anonymous survey that asks participants to disclose their declared major.

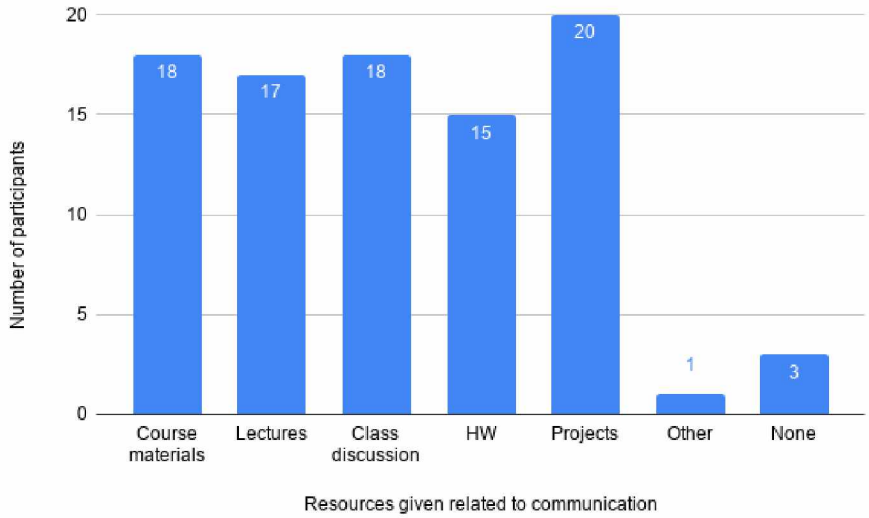

Figure 3. Results for question four of the anonymous survey that asks participants to select the resources they have been given related to communication.

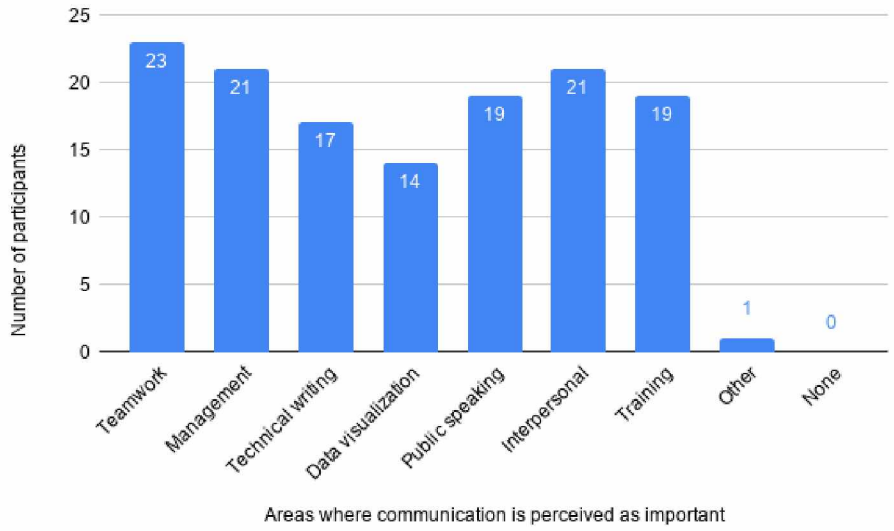

Figure 4. Results for question seven of the anonymous survey that asks participants to select the areas where they perceive communication to be important.

Sender-receiver model. Question five asked participants to give their perception of communication based on the resources they had been given in their classes. Many of the participants gave similar answers with a general statement regarding the transferring of information, such as "Communication is where two or more individuals share ideas", "Communication is the key to providing factual information as mentioned by society and connecting globally", and "Communication is the act of getting an idea or thought successfully understood by another party". The question that followed, question six, asked the participants what communication meant to them and most were very similar to answers for question five. Examples include "Transferring thought", "Being able to clearly express your thoughts so that others may understand", "The ability to transfer information in an effective manner to others", and "A way of effectively transferring knowledge and ideas from one person to another".

Faculty and classmates. Many participants that completed the open-ended questions five, six, and eight mentioned their communication experiences from and with faculty members within their department. Responses were often regarding their professor's communication.

Examples include "Some of my professors are from other countries so the language barrier makes learning more difficult", "Some professors are unable to communicate at a level students new to the subject can understand", "Professors in our department are sometimes hard to listen to", and "Better communication could always be had within the classroom. Some professors are good at teaching and using the whiteboard and power points to aid in their lectures and some are silent or read directly off the slides. It is especially important to gauge how when the students are doing with simple quizzes or questions. If the majority of the students did not get the question or quiz correct, then the professor has failed in communicating."

If the participant was not describing faculty communication in particular, they were describing their fellow classmates with group work, such as "During group projects, where people's expectations of each other are often unclear", "Group projects; many students struggle with communicating goals and expectations", and "When other students cancel a meeting at the last minute when it could have been prevented by making a decision and expressing it to group mates earlier in the week".

God-terms. Participants responded to question five and six similarly and their responses varied in length and depth since these were open-ended questions. Therefore, in order to find any consistent terms within the responses for question five and six, a word cloud (Figure 5) was created in order to identify any patterns. The words *communication* and *means* are most likely used often due to the questions directly asking about communication and asking the participants to explain what communication means to them. What is interesting to note is the other consistent terms, such as *others, ideas, important,* and *effectively*. When looking at the context of the answers that included these terms, there is a reference to the basic Shannon-Weaver model of knowledge being transferred from one to another (i.e. ideas and others). The idea of

communication being important was identified as a pattern as well with many participants seeing communication as important. The word *effectively* was also noted as a word that came up with some participants. When looking at the context of how this word is used, the participants use it as a word to explain the communication process, such as "The ability to talk to coworkers and clients at your job and effectively convey your topics and ideas" or "It is important to communicate effectively to avoid mistakes". The words effective or effectively were used by six participants a total of seven times when answering the open-ended questions regarding what their perception of communication is and what communications means to them.

Figure 5. Word cloud generated from most used words in survey questions five and six regarding perceptions of communication based on resources given and what communication means.

Quantitative Analysis

A chi-square test was conducted regarding class standing (freshman, sophomore, etc.) and perceived applicability of communication with area of study (i.e. survey question seven) in order to determine dependence of these two variables. The data provided did not

produce a p value that reached a level of significance and, therefore, does not indicate that one variable affects the other.

Discussion

Agenda Without Salience

Effective communication is the end product, but what it takes to get there is not fully established or assessed. The use of *effective* to describe communication in various rubrics, materials, and the ABET criteria suggests the use of god-terms in reference to communication. Even though communication does seem to be portrayed as important through the course materials and the student survey responses, the use of the word *effective* or *effectively* does not give context into shaping the meaning of communication.

By using the term *effectively*, it does not give any context into how communication is viewed, applied, or measured within the engineering realm. From the themes identified in the course materials, *effectively* was used in some materials related to communication. Faculty do emphasize communication and it is framed as an important skill for students to learn. In fact, students did express communication as important in their answers to the open-ended survey questions. However, the students themselves showed a pattern of using *effective* or *effectively* to describe communication. That being said, an agenda is being set that communication is important, but the agenda is using language that is not necessarily accessible or fully understood nor does it allow for proper measure or assessment. What does *effectively* communicating mean within the engineering discipline? How does one measure or assess *effective* communication? How does a student or faculty member know if communication is being *effective*? This connects back to a previous point made regarding the focus being on the end product versus the process

(Lingdard & Barkataki, 2011). Effective communication is the end product, but what it takes to get there is not fully established or assessed.

From the qualitative analysis, analytical thinking, as mentioned by Lumsdaine and Lumsdaine (1995), is evident in the course materials provided to students. However, the majority of the course objectives, assignments, and materials are focused on working together and allowing students to practice teamwork. Therefore, it makes sense that the students would rank teamwork, management, and interpersonal skills as the top applications of communication within their field. Engineering students are given a plethora of opportunities to work together as a team and collaborate within the class setting. Referring back to Lingdard & Barkataki (2011), students are given assignments and projects, but the quality of the end product is examined more than the quality of work to get the end result. The course materials that were provided did not show evaluation by the instructor regarding interpersonal communication from students with their group members throughout the duration of a project. A majority of the evaluation materials provided are based on the final project with only a few evaluations based on the students giving each other feedback. Therefore, the evaluation tools focus more on the end product rather than the process to achieve the end product. In fact, one participant stated "but very rarely are we tested on our ability to effectively communicate." Using peer evaluation to assess interpersonal communication skills can be beneficial, since getting input from those that directly work with the student can indicate clear accomplishments and issues. Additionally, university faculty observations of student interaction can be further beneficial through seeing situations with a more experienced and professional lens.

Communication by Example

When answering questions five and eight (perceptions of communication and where communication could be better), the majority of those that answered the question referred to a lack of communication skills from faculty or fellow students within the department. Often, the participants would give examples related to their interactions with faculty and their fellow classmates. Interaction with others, particularly with faculty or mentors, could be argued as a resource given to students at the institutional level. In fact, several participants stated "I really can only learn by example...", "I learn the most about what is expected and needed directly from my professors and the department admin," and "It would have been helpful with professor student relationships." Even though this was not listed as a resource for students to check within the survey, the students made it clear in the open-ended questions that the faculty's interpersonal communication skills and abilities are a key component in their understanding and perception of communication.

Conclusion

Key themes were identified qualitatively between the course materials examined and the anonymous survey data. This suggests that the resources given to engineering students have set an agenda at the institutional level regarding communication. Through qualitative analysis, a common theme from the course materials and the perceptions from students include a basic representation of communication (i.e. transferring information from one to another).

Break Apart the God-terms

Even though students do show a form of understanding of communication through this basic model, there is a common theme among the engineering curriculum and some of the student participants to use the god-term *effective* or *effectively*. The agenda attempts to be set by

using god-terms to describe communication. However, this does not necessarily provide a clear foundation for the agenda due to lack of definition, understanding, or assessment. These terms need to be better defined and given clarity regarding the context and what is expected as effective communication within the context of the assignment and professional expectations.

Process vs. Product

This leads to the second theme of focusing on the end product when it comes to communication. With the curriculum and the ABET criteria using the word *effectively*, this does not provide a clear definition or understanding of what or how to assess communication within engineering. Therefore, with this lack of context and the curriculum lacking assessment of interpersonal communication skills, engineering students are evaluated based on the end product instead of the process. For example, the quality of a group report rather than team member interactions throughout the process. In fact, the results suggest that some students do have communication issues with their fellow classmates during group work. However, these communication issues may not be assessed or properly addressed in the classroom. Therefore, further emphasis on the process of achieving the end-product would be beneficial within the curriculum.

Mentorship

Students see interpersonal communication skills from their professors and department as a key component of their understanding and perception of communication. With the open-ended questions in the survey, students took the initiative to mention and focus on their interactions with faculty. For students to interpret the survey questions in this way and decide to focus on the communication skills of their professors, this suggests that this is an important topic at the forefront of many students' perceptions and thoughts regarding communication.

With this basic understanding of communication, god-terms used to describe communication, and focusing on the end-product rather than the process, students are forced to look to the faculty for a better understanding of communication. Survey responses suggest that students look to the faculty to learn communication skills through example, particularly interpersonal communication. Therefore, students look to faculty as role-models when it comes to interpersonal communication skills, which is significant since the knowledge gap between industry needs and college graduates centers around interpersonal communication. Interpersonal communication skills are important for co-production, teamwork, and collaboration; skills that are clearly emphasized within the engineering program course curriculum through assignments and projects. However, with much emphasis on students working together, there needs to be emphasis on faculty working with students (i.e. mentorship). In order to encourage interpersonal communication development, engineering students should be encouraged to think outside of the equation or structures that they are given. Instead, students should be given more one-on-one mentorship on an individual or customizable level. The agenda needs to be reset by giving students and instructors more guidance regarding communication skills and needs by avoiding god-terms that lack substance and provide a better understanding of concepts and ways for assessment. By giving more guidance in terms of communication and creating more mentorship opportunities, this would help students rise to industry's call.

Limitations

Setting a search criteria to collect data for the College of Engineering and Mines could exclude some engineering disciplines. For example, examining a particular college does not necessarily include students that are pursuing an interdisciplinary degree. Some faculty at universities come and go annually and some classes have multiple sections with different

instructors that are offered to students. This could cause an inconsistency with the data with different faculty teaching certain courses or some students having different instructors for the same class. Course descriptions that are available on the institution's website do not necessarily depict all elements or objectives of the courses. The inclusion of communication based materials for given courses can be dependent on the instructor and their own objectives for the course. The university's course catalog was not necessarily reflective of which courses discuss communication related topics or communication tasks. Instead, more communication focused courses were found through asking the departments directly. This limitation could be due to different faculty priorities when teaching courses and having different levels of emphasis on various components of the class. Furthermore, the in-person classroom environment was not observed, which means peer and faculty interactions regarding communication were not taken into account.

Future Research

After conducting this study and conducting an extensive literature review, it is clear that more studies are needed regarding what students perceive to be important skills for various areas of study. Furthermore, more research is needed that collectively focus on student perceptions of what is important to their career choice compared to employer or industry need. This will allow for more knowledge gaps to be recognized and addressed at the institutional level. Most importantly, interpersonal communication skills and how they are being taught as well as assessed within specific disciplines need to be addressed and provide instructors more guidance on improving these skills in the classroom. This study showed a clear interpersonal communication development within the classroom, which creates uncertainty within the realm of online teaching, particularly within the engineering discipline. Research is needed to specifically

address the role of interpersonal communication within engineering classes and programs offered online.

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